Welcome

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CS445: Intro Graphics
University of Virginia, Fall 2003

Overview

• Introduction
  ▷ What is computer graphics?
• Applications
  ▷ What is it good for?
• Syllabus
  ▷ What will I learn in this course?
• Coursework
  ▷ How much work will there be?

What is Computer Graphics?

• Sliced by specialty
  ▷ Imaging = representing 2D images
  ▷ Modeling = representing 3D objects
  ▷ Rendering = building 2D images from 3D models
  ▷ Animation = simulating changes over time
  ▷ Hardware = computer architecture for graphics

What is Computer Graphics?

• Sliced by task
  ▷ Creating pictures on a computer
  ▷ Interacting with those pictures
  ▷ Drawing those pictures faster
  ▷ Displaying those pictures bigger, brighter
  ▷ Simulating physical phenomena
  ▷ Visualization of complex data
  ▷ Acquiring real-world geometry
  ▷ Simulating plants
  ▷ Video games
  ▷ Breaking stuff
  ▷ ...
### Why is Graphics Cool?

- **Interdisciplinary**
  - Biology, Physics, Math, Psychology, CS, Art
- **Visual**
- **Interactive**
- **Work can be demoed to non-techies (e.g., parents)**
- **Movies**
- **Games**
- **Money**
  - Video games: $9.4B (2001)
  - Movies: $8.5B (2001)

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### Entertainment (passive)

- Final Fantasy (Square, USA)
- A Bug’s Life (Pixar)
Entertainment (Active)

Circus Atari (Atari)

Entertainment (Active)

Doom III (id Software)

Graphical User Interfaces

Window system and large-screen interaction metaphors (François Guimbretière)

Graphical User Interfaces
<table>
<thead>
<tr>
<th>Computer Aided Design</th>
<th>Scientific Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Airport (Bill Jepson, UCLA)</td>
<td>Airflow around a Harrier Jet (NASA Ames)</td>
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<tr>
<td>Gear Shaft Design (Intergraph Corporation)</td>
<td>Boeing 777 Airplane (Boeing Corporation)</td>
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</table>
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Image Processing

• Image Representation
  ◦ Sampling
  ◦ Reconstruction
  ◦ Quantization & Aliasing

• Image Processing
  ◦ Filtering
  ◦ Warping
  ◦ Morphing
  ◦ Composition

• Raster Graphics
  ◦ Display devices
  ◦ Color models
<table>
<thead>
<tr>
<th>Rendering</th>
<th>Modeling</th>
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<tbody>
<tr>
<td>• 3D Rendering Pipeline</td>
<td>• Representations of geometry</td>
</tr>
<tr>
<td>◦ Modeling transformations</td>
<td>◦ Curves: splines</td>
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<tr>
<td>◦ Viewing transformations</td>
<td>◦ Surfaces: meshes, splines, subdivision</td>
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<tr>
<td>◦ Hidden surface removal</td>
<td>◦ Solids: voxels, CSG, BSP</td>
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<tr>
<td>◦ Illumination, shading, and textures</td>
<td>• Procedural modeling</td>
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<td>◦ Scan conversion, clipping</td>
<td>◦ Sweeps</td>
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<td>◦ Hierarchical scene graphs</td>
<td>◦ Fractals</td>
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<td>◦ OpenGL</td>
<td>◦ Grammars</td>
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<tr>
<td>• Global illumination</td>
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<td>◦ Ray tracing</td>
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<td>◦ Radiosity</td>
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<td>◦ Monte Carlo</td>
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<td>Animation</td>
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<td>• Keyframing</td>
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<td>◦ Kinematics</td>
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<td>◦ Articulated figures</td>
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<td>• Motion capture</td>
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<td>◦ Capture</td>
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<td>◦ Warping</td>
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<td>• Dynamics</td>
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<td>◦ Physically-based simulations</td>
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<td>◦ Particle systems</td>
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<td>• Behaviors</td>
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<td>◦ Planning, learning, etc.</td>
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Coursework

- Exams (25%)
  - In class (Oct 16 and Dec 2)
- Programming Assignments (every two weeks) (50%)
  - Impressionist Painting (due Sep 9)
  - Image Processing (due Sep 23)
  - Ray Tracer (due Oct 7)
  - Circles (due Oct 21)
  - Rubik’s Simulator (due Nov 6)
  - Programmable Shading (due Nov 20)
- Final Project (25%)
  - Do something cool!

Programming Assignments

- When?
  - Every two weeks
- Where?
  - Anywhere you want, e.g. home or Olsson 002
- How?
  - Portable code, so any OS you like
  - But we have to grade it!
  - C and C++, OpenGL, GLUT
- What?
  - Basic feature lists
  - Extra credit lists
  - Art contest

Art Contest

- Everybody should submit entries for each assignment!
  - 5 points for submitting something non-trivial
  - 20 points for winning (complain to TA about losing)
- Definitely save “accidental art”

Collaboration Policy

- You must write your own code
- You must reference your sources of any ideas/code
- It’s OK to …
  - Talk with other students about ideas, approaches, etc.
  - Get ideas from information in books, web sites, etc.
  - Get “support” code from example programs
    - But, you must reference your sources
- It’s NOT OK to …
  - Share code (no matter how trivial) with another student
  - Use ideas or code acquired from another sources without attribution
  - Directly debug another student’s program (i.e., by looking at their code)
- Do not test us on this – zero tolerance in effect
Administrative Matters

- Instructor: Greg Humphreys
- Office Hours: Friday 2-4
- TA: Gordon Marx
- Office Hours: ?

Book

More, more, MORE!

- Sequence of advanced graphics courses at UVA:
  - CS 446: Real Time Rendering (Dave Luebke)
    - Building interactive graphics systems (games!)
    - Next semester
  - CS 447: Image Synthesis (Me)
    - Modeling light and materials (Rendering)
    - Fall 2004
  - CS 448: Animation (David Brogan)
    - Modeling movement
    - Spring 2004 (and right now)

Movie Time